PROCEEDINGS

OF THE NINETEENTH ANNUAL

WESTERN FOREST INSECT WORK CONFERENCE

Berkeley, California

March 4-7, 1968

<u>Not for Publication</u>

(For information of Conference Members only)

Prepared at

Division of Timber Management
Insect and Disease Control Branch
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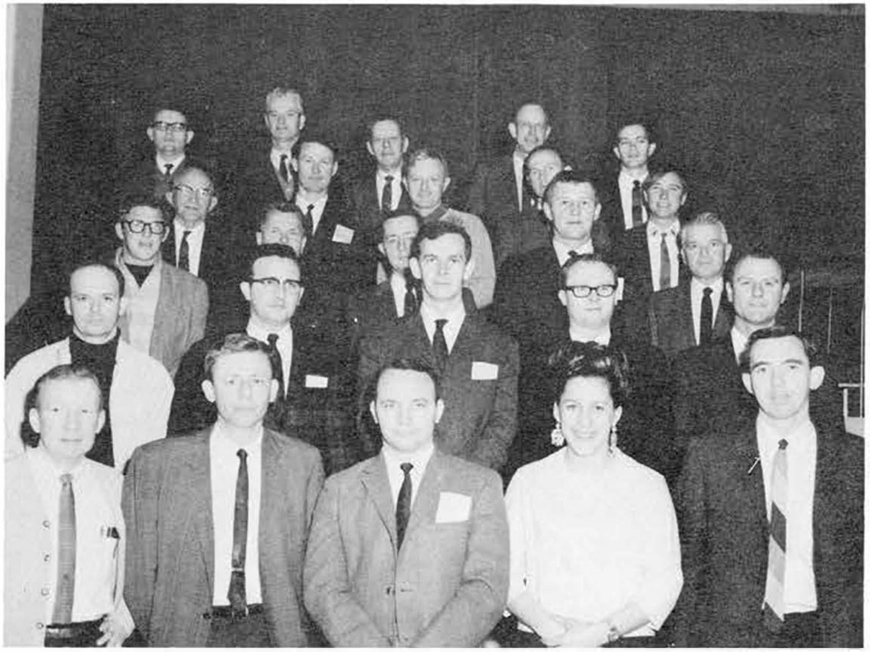
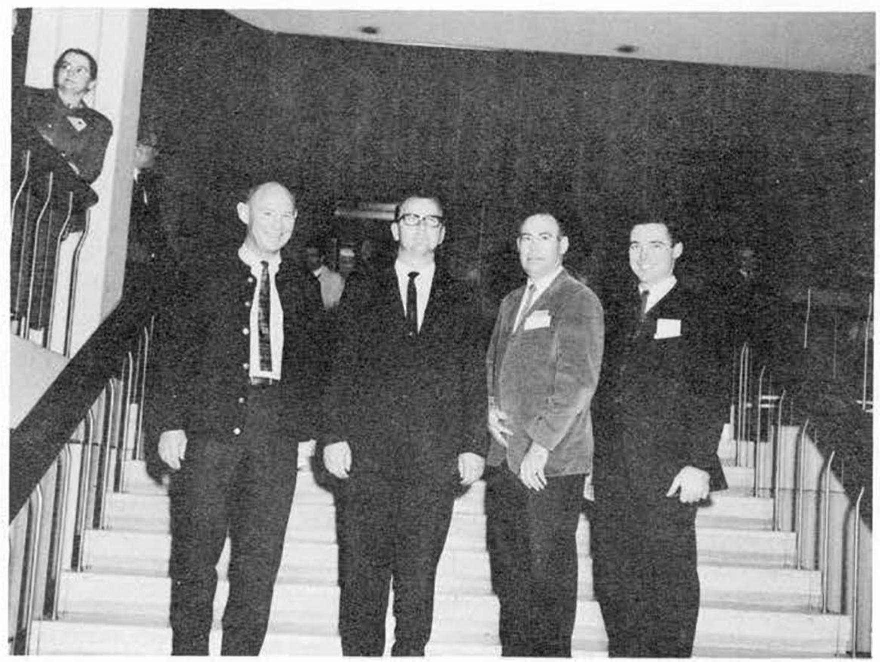
Region Four
Ogden, Utah



PICTURE A (Upper Left)

Row 1 (L. to R.) Red McComb, S. L. Krugman, C. Sartwell, Isabella Moeck, John Chansler.

Row 2 (L. to R.) Don Curtis, Mark McGregor, Henry Moeck, LeRoy Klein, Dick Smith.

Row 3 (L. to R.) Chas. Tierman, Bob Heller, Brent Teillon, Paul Lauterback, Art Moore.

Row 4 (L. to R.) Ralph Hall, Don Schmiege, Bob Stevens, Bob Lyon, Bill Bedard.

Row 5 (L. to R.) John Hard, John Wear, H. A. Richmond, Bill Coulter, Gerry Daterman.

PICTURE B (Upper Right)

Row 1 (L. to R.) James Harper, Les Safranyik, Paul Tilden, Barbara Barr, Stan Barras.

Row 2 (L. to R.) Fred Stephen, Mel Furniss, Don Dahlsten, Carroll Williams, Joe Saunders.

Row 3 (L. to R.) Dave Crosby, John Laing, Dick Pillmore, Allan Berryman, Cal Massey.

Row 4 (L. to R.) John Pierce, Mona Lambden, Imre Otvos, Mike Yost, Bill Waters, Calvin SooHoo.

Row 5 (L. to R.) Gerald Bringuel, Tom Koerber, Paul Baldwin, L. M. Gardiner, Lewis Edson.

PICTURE C (Lower Left)

Row 1 (L. to R.) Dick Washburn, Les McMullen, Don Pierce, Bob Dolph, Dick Hunt.

Row 2 (L. to R.) Bob Hubbell, Alen Hedlin, George Struble, Paul Buffam, Rick Johnsey.

Row 3 (L. to R.) John Schenk, Dick Schmitz, Karel Stoszek, Roy Beckwith, Ken Graham, Dan DoHa.

Row 4 (L. to R.) Doug. Ross, Al Rivas, Boyd Wickman, David Dyer, George Downing, Bob Gustafson, John Harris, Roy Blomstrom.

PICTURE D (Lower Right)

Row 1 (L. to R.) Galen Trostle, Loyd Browne, C. J. DeMars, Alan Cameron.

PROCEEDINGS
of the Nineteenth Annual
WESTERN FOREST INSECT WORK CONFERENCE
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EXECUTIVE COMMITTEE (Nineteenth Conference)

R. I. Washburn, Moscow	Chairman
J. M. Kinghorn, Victoria	Immediate Past Chairman
G. C. Trostle, Ogden	Secretary-Treasurer
R. E. Stevens, Berkeley	Councilor (1965)
R. E. Stevenson, Calgary	Councilor (1966)
J. F. Chansler, Denver	Councilor (1967)

D. L. Wood, Berkeley, 1968	Program Chairman

EXECUTIVE COMMITTEE ELECT

E. D. A. Dyer, Victoria	Chairman
R. I. Washburn, Moscow	Immediate Past Chairman
L. H. McMullen, Victoria	Secretary-Treasurer
R. E. Stevenson, Calgary	Councilor (1966)
J. F. Chansler, Denver	Councilor (1967)
P. G. Lauterback, Tacoma	Councilor (1968)

D. E. Schmiege, Juneau	Program Chairman 1969

Prepared by the Secretary-Treasurer, G. C. Trostle, from summaries submitted by Workshop Leaders. Stenographic services and duplication processing provided by the Insect and Disease Control Branch of the Division of Timber Management, U. S. Forest Service, Region Four.

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NINETEENTH ANNUAL WESTERN FOREST INSECT WORK CONFERENCE

March 4-7, 1968

The Conference was convened at 9:30 a.m. on March 4, 1968, by Chairman Richard Washburn with the opening of the Initial Business Meeting.

MINUTES OF THE INITIAL BUSINESS MEETING

The meeting was called to order by Chairman Washburn who then requested the observation of a silent moment in memorium of Dr. Sam Graham and Don DeLeon, Forest Entomologists, who died during the past year. Their contributions to Forest Entomology will be long remembered.

Recognition was also given to Paul Grossenbach who retired since our last meeting.

The Chairman then appointed C. J. DeMars, Ken Graham, and Calvin Massey, as nominating committee and charged them to choose a slate for the office of Chairman, Secretary-Treasurer, and a Councilor to replace Bob Stevens.

Treasurer's Report was read and accepted upon motion by McComb and seconded by Stevens.

Minutes of the final business meeting for 1967 was read and approved.

The Chairman then discussed the items brought forth in the Executive Meeting; the chair opened the meeting for a discussion of the 1970 meeting; Red McComb extended an invitation to the Work Conference to hold their meeting in Portland in 1970.

The Chairman turned the chair over to Dave Wood and Bill Bedard for the discussion of the current conference.

New members were introduced and old members were encouraged to make themselves known to them.

John Shank and Calvin SooHoo moved that meeting be adjourned; it was so ordered by Chairman at 10:10.

NINETEENTH ANNUAL

WESTERN FOREST INSECT WORK CONFERENCE

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PEST MANAGEMENT AND FOREST ENTOMOLOGY

Monday, March 4

8:00 - 9:00 Registration

9:00 - 9:45 Initial business meeting

9:45 - 10:00 Coffee break

10:00 - 12:00 Concurrent workshops led by keynote speakers

Pest Management and Forest Entomology

Workshop #1

Leader: R. F. Smith
Secretary: Ken Graham
Participants: J. O. Keith; C. Sartwell, Jr.; G. C. Trostle

Workshop #2

Leader: A. D. Moore
Secretary: A. A. Berryman
Participants: M. D. Atkins, D. L. Dahlsten, E. G. Hunt

Workshop #3

Leader: R. van den Bosch
Secretary: J. A. Chapman
Participants: R. W. Reid, H. A. Richman, B. E. Wickman

Workshop #4

Leader: R. L. Rudd
Secretary: R. L. Lyon
Participants: J. H. Borden, R. C. Hall, W. P. Nagel

Workshop #5 (tentative)

Leader: H. J. Vaux
Secretary: R. E. Stevens
Participants: R. N. Blomstrom, M. W. Kirby, W. E. Waters

12:00 - 1:00 Lunch

1:00 - 2:45	Continue morning workshops
2:45 - 3:00	Coffee break
3:00 - 4:30	Continue morning workshops
4:30	Champagne reception - Stevens Room, Student Center

Tuesday, March 5

7:30 - 5:00	Tour of Bogg's Mountain State Forest
	Discussion of root diseases and bark beetles - F. W. Cobb
	Discussion of model pest management program (grapes) with field examples - R. L. Doutt

Wednesday, March 6

8:00 - 9:45	Report from workshop secretaries
9:45 - 10:00	Coffee break
10:00 - 12:00	Concurrent workshops:
	Probability sampling as a tool in remote sensing - R. C. Heller
	Interrelationship of bark beetles, micro-organisms and host trees - S. J. Barras
	Vertebrate predation - P. H. Baldwin
12:00 - 1:00	Lunch
1:00 - 2:45	Concurrent workshops:
	Evaluation of forest insect populations - W. E. Waters
	Population genetics of forest insects - K. Graham
	Insect pheromones and plant attractants - D. L. Wood
2:45 - 3:00	Coffee break
3:00 - 5:00	Concurrent workshops:

Possibilities of integrated control of the spruce budworm - C. B. Williams, Jr.

Aids in decision making in forest insect control - C. J. DeMars

Biological control of bark beetles - J. P. Vité

7:30	Banquet

Thursday, March 7

8:00 - 9:45	Concurrent workshops:
	Operational aspects of pest management - G. C. Trostle
	Breeding resistant trees - S. L. Krugman
	Microbial control of forest insects - L. A. Falcon
9:45 - 10:00	Coffee break
10:00 - 12:00	Summaries of Wednesday and Thursday workshops
12:00 - 1:00	Lunch
1:00 - 2:00	Final business meeting
2:00 - 2:15	Coffee break
2:15 - 4:15	Panel discussion - keynote workshop leaders

WESTERN FOREST INSECT WORK CONFERENCE

Summary of Workshops

Workshop # 1. Leader: R. F. Smith; Secretary: K. Graham

Theme: Integrated Control.

Dr. Smith, a pioneer in the concept of integrated control of pests in agriculture, emphasized that the increasing need for protection, plus the increasing importance of the consequences of our actions, are forcing us to take a new look at pest control in forestry. In place of the traditional single-track approach, which has failed to provide adequate control, and through zealous over-use has led to injurious side-effects, we need to consider pest control as an over-all objective in which all pest control resources are integrated. In this field, we may learn some lessons from agriculture, while at the same time recognizing certain essential differences which affect our decisions.

In forestry we are more often dealing with native trees and native pests; the crop periods, and thus the investments are longer - termed in forestry than in agriculture; the margins of profits per acre per year are narrower; forestry is presently less prepared to deal with economics of land productivity; forest entomology is more ecologically based, has less complete control over the cultural situation, but must depend extensively on applied ecology for protection; in forestry ownership is more in large holdings with smaller controlling groups. In agriculture, the rapid changes in varieties, culture, and harvesting cause problems in anticipating methods for the future.

The workshop discussions centered about the following topics: What are the necessary elements for pest control decisions?
What are the obstacles to implementation of integrated control?
How may we hope to put integrated control programs into action?
How can economic thresholds be better defined?

What are the necessary elements for pest control decisions?

Pest control decisions must rest on more than purely entomological considerations.

What values are at stake: social and commercial? We must think beyond the immediate dollars and cents values of wood utilization, and include recreational values, as well as considering the social impact of the loss of livelihood of a forestry based community.

What are the consequences of taking no action? These are judged first in terms of biological impact, and then translated into economic terms.

What tools are available for assessment, research, and control, including various alternatives for control?

What will be the likely consequences of action in terms of protection gained by specific methods used to various degrees of application? What will be the costs and possible side effects?

What are the obstacles to implementation of integrated control?

Present lack of basic information is only one of numerous factors limiting our attainment of integrated control. Equally important is the translation of theory and basic facts into operational methods. In turn the communication gap is widened by the organizational gap between the specialist who may not even be an entomologist, and the manager. Also, there is need for better communication of information to those who may be able to use it.

Another important problem is in selling new ideas. This is partly a matter of communicating our information in a meaningful form, of building up confidence by convincing forest managers that our proposals are realistic. Selling of a new idea is also a matter of psychological timing, such as on occasions when public concern opposes other methods or is receptive to a new approach.

Motivation for protection of his timber is a key consideration of the forest manager. This in turn depends on the nature of forest land tenure under which he is operating. His attitudes and receptivity for a particular method, or any method, will depend on whether he is responsible for his own protection, or whether he regards it as a public responsibility; i.e., tax-supported. Another factor in forest managers' attitudes is their unwillingness to look far ahead.

Attitudes, especially governmental, towards preventive methods as opposed to combat efforts, are an obstacle to the pursuit of integrated control. Congressional law tends to favor appropriations for the more tangible insect enemy which exists, over the prevention of its initial expansion to an outbreak condition.

Certain practical considerations limit our choice of method. The time factor is important when an outbreak already exists, and when therefore an emergency course of action must be taken if catastrophic damage is to be prevented. Thus man-hour-dollars to achieve results may be limiting.

Our attitudes toward emergencies tend to affect our decisions, since we are inclined to react to what could, theoretically, happen rather than to what we can predict, probabalistically, is likely to happen.

Public attitudes, either majorities or minorities, sometimes backed by political forces, may compel us into courses of action which are at variance with the ideals of integrated control. For example, for aesthetic reasons, a public group may demand a type of protection which is inferior in the long run. On the other hand, we could be deprived of the legitimate use of chemical control within the framework of integrated control because of public opinion.

The changing of forest managers' habits is a problem of overcoming psychological blocks to new, and to them, uncertain methods. This is also a matter of establishing confidence for our "product."

How may we hope to put integrated control into action?

-Aim to adapt the scientific facts and theory to a working form by bringing together the scattered bits of information, interpreting their practical implications, and conducting developmental research on the new ideas.

-Do a better job of communication by translating the scientific jargon into meaningful operational terms.

-Improve the surveillance programs.

-Improve the definition of economic thresholds to which integrated control may be directed.

-Aim at end results of pest management rather than equating the killing of insects with pest control.

-Do a better job of selling ideas to forest managers by better communication, establishing confidence that we understand the manager's problems and viewpoints, and that we are realistic. We should also seek to change people's habits from established patterns where a new idea is ignored because familiar methods hold the field.

How can economic thresholds be better defined?

-We must differentiate different forest uses which require different degrees of protection.

-Commercial forests - timber use.

-Recreational forests - fewer insects and lower degree of damage may be tolerated.

-Christmas trees.

-Watershed.

-Then we must define the different standards for these.

-Ascertain impact of attack on the forest resource of an area.

-Understand the ecology of the insect concerned.

PEST MANAGEMENT WORKSHOP #2

Leader: A. D. Moore - Recorder: A. A. Berryman

The discussion opened with various definitions of pest management. There was some dissatisfaction with this term and the alternatives regulation and integrated were proposed. In general, it was agreed that "pest management" should be based on:

1. Ecological approach.

2. Integrated control.

3. Utilizing "weak" spots in the life history of the insect.

4. Custom made methods for each species.

5. Based on sound economic guidelines.

It was felt that entomological problems should fit into the multiple-use concept. Considerable discussion revolved around the research approach; i.e., problem oriented research (crash program) vs. process or system orientated research. It was generally conceded that systems analysis was more realistic in the face of complex population processes but that this necessitates research teams, communication, and feedback between disciplines involved and the basic and applied aspects. It also brought out the pressing need for trained professionals in systems analysis, particularly in the biological sciences.

The administrative and legislative difficulties of team research programs were discussed and it was generally felt that the onus is on the scientists themselves to get together and plan these programs. Priorities and directions should be set by the group of scientists rather than the administration.

Discussion then moved to insecticide use and misuse. The necessity for systems analytical methods to study the effect of insecticides on the ecosystem was stressed. On the other hand the ostracism of certain chemicals (i.e., DDT) and substitution with less understood chemicals may lead to more complex problems (i.e., organophosphates on cotton). Such "panic" procedures were considered unscientific.

The need for specific insecticides for use in pest management was discussed. Specificity may be induced by (a) selective chemicals, (b) dosage, (c) timing of application. Most control projects use too much insecticide giving rise to waste and contamination. Ultra-low volume techniques will help solve this problem. Some carbamates seem useful in ULV work with aphids, particularly as lethal effects are sometimes passed on to succeeding generations. Possibilities for using the insect pest or host plant to change the molecular structure of the insecticide to a more toxic form were also discussed.

On the subject of pesticide registration, it was felt that the opinions of all involved groups should be sought, including industry, public health, scientists, etc., on registration problems. The profit motive, and its position in insect control, received active discussion. Opinions were expressed that too much emphasis was being placed on research on chlorinated hydrocarbons and that wildlife and chemicals were not mutually exclusive.

The discussion then shifted to the future of forest management, with shortened rotation, mechanized manipulation and harvest, and fertilization. Problems involved with fertilization causing increased rodents, aphids, and smog were mentioned. It was generally agreed that the mechanization and monoculture of wood would probably inherit some of the advantages and disadvantages of agriculture.

Report Workshop #3, Biological Control

Leader: R. van den Bosch   Secretary: J. Chapman

Introduction

The leader gave a critique of pest control from the viewpoint of an agricultural entomologist. About 25 years ago DDT launched a new era. Previous chemical treatments were primitive. Other potent new insecticides followed DDT. The resulting revolution in pest control elbowed out the ecological approach. Chemicals attained the dominant role and still have it. A recent tide of concern over use of insecticides has resulted in some new controls and regulations, but concern is usually limited to mammals and other vertebrates. It doesn't include the large arthropod component of the ecosystem. Ecological considerations are not influencing chemical control procedures sufficiently.

Cotton Insects as an Example

Cotton in California is a 300 million dollar crop, involving annual sales of 20 million in insecticides, for which some 100 companies compete. Toxicology and marketing dominate and the ecological approach is overwhelmed. The grower is persuaded with modern sales methods in favor of insecticides. Some companies even run their own extension courses. Recommendations of the Experiment Station are overridden. A serious "credibility gap" exists. But chemical control is becoming more expensive, and more treatments are needed. Yields are not improving enough, so that growers are operating on a smaller profit margin and some are in trouble. Former use of longer lasting chlorinated hydrocarbons has been replaced by shorter term effect organophosphates. Cotton boll worm, formerly controlled, is now moving in and becoming more serious. Up to 95% of its populations may be destroyed by arthropod predators and parasites, but this influence has been largely removed by more frequent applications of organophosphate insecticides. Some new insecticides are posing a serious threat to wildlife. Scientific pest control has lost, and the rational approach has been defeated. Situation is similar in the citrus fruit industry.

Needed Approach to Pest Control

Pest control should be an exercise in ecology. An integrated effort is needed and any one-sided approach is unsatisfactory. Chemical control has a part to play. We can't stop using insecticides as the agricultural environment is now ecologically unbalanced and a change must be gradual. Use of insecticides should be more limited, (i.e. use of selective insecticides, treatment limited to "hot spots") and combined with other procedures. Entomologists are partly responsible

for the present situation in that they have usually taken a specialist and limited view of problems. This is no longer sufficient. Pest control is becoming very sophisticated and needs a team approach. Present work on the cotton insect problem involves a "task force," considering all aspects of the growth of cotton.

Pest Control in Forestry

It was suggested that if pest control in Forest Entomology takes the same course as in agriculture, it is doomed to failure. During the discussions several differences between forest and agriculture were brought out:

1. Forestry is still in its infancy in North America. Scientific forestry has barely begun.

2. The time required for the crop is very different and this has many consequences. A forest may go through several cycles of insect abundance before it is used. Cost of treatment must be considered as a long term investment. What treatment can be done is limited and must be tied to what the forester is going to do anyway, in silviculture or management.

3. Larger areas are involved in forests, giving rise to many physical difficulties of survey and control.

4. Landownership differs. Forestry is dominated by large companies or public agencies and has a "technocracy," in which decisions are made by professional, experienced men. Companies or agencies have a longer term interest than individuals. Government is in a better position to influence companies (through tax structure, regulations, licenses, etc.,). A large number of small landowners may have more political influence than a few large companies.

5. Multiple use of forest land is common and there is considerable variation in productivity. Also, the future form in which forest products will be marketed is not clear at this time.

Biological Control and Forest Pests

Discussion was limited to bark beetles.

Douglas-fir beetle.

There are some 18 species of arthropod and other natural enemies: mites, nematodes, clerids, ostomids, cucujids, Coeloides, Medetera and others, but all seem to account for only limited mortality--perhaps around 20%.

The question was raised: how could any of these predators or parasites be increased, or assisted in their actions? There was no answer. The question was raised as to whether a natural enemy should be introduced into part of the host range where it is not naturally found. It was suggested that this would be dangerous without knowing much about what all predator and parasite species are actually doing. When dealing with a complex of arthropod associates it does not necessarily follow that better control will result by increasing the numbers of species affecting the host. A specific example in this discussion was a Pteromalid parasite, found in only part of the range of the Douglas-fir beetle, but accounting for a reduction in eggs of up to 60%. It was pointed out, however, that by reducing intra-specific competition such a parasite may actually increase the number of the host species. This same possibility was suggested in the case of woodpecker predation of spruce beetle. Careful study and analysis should precede any introduction or transport of a native predator or parasite species to help control a host.

Spruce beetle.

There is a similar picture of invertebrate associates here, and woodpeckers appear to be relatively more important, spruce having thinner bark. It is considered that the complex of natural factors, including low temperatures and biological associates, actually did stop the large spruce beetle epidemic in Colorado. Man's efforts were probably inconsequential. Woodpeckers are important directly with this species and also indirectly, by reducing bark thickness and allowing parasites to reach host more easily.

Western pine beetle.

Woodpeckers aid parasite establishment in this species, also. A monograph report on population dynamics is expected to be published soon. Up to 40 invertebrate associates of this beetle are known. However, their total, combined effect is apparently usually not great.

Southern pine beetle.

Woodpeckers important with this species at times, and are indicators of health of brood. Woodpeckers do not work much on smaller attacked trees and it was found that brood in these trees was not as healthy as in larger trees. Populations of this beetle may act differently at different times of a given year. This is a reflection of density of flying population, in turn related to synchrony of emergence. Also, the species acts quite differently in loblolly pine than in long leaf pine, and Arizona populations are different in various ways from Texas populations. This illustrates how complex a biological problem some pest species are.

What Can Be Done to Control Forest Insects Without Insecticides?

The best example of a management practice which has had some success is the California risk rating system, which serves as a guide to selective logging of ponderosa pine. It has reduced loss from western pine beetle in east side Sierra stands, but not so much in west side stands. On the other hand some normal forestry practices may worsen the effects of an insect pest. Thinning may reduce the hazard of one insect pest but it also opens stands, often resulting in more windthrow and thus providing more breeding material. Chemical thinning may also be hazardous in terms of insect increase by providing breeding material. Leaving logs for emergence of parasites may be harmful rather than helpful as they may produce more bark beetles. Use of pheromones may affect predators and parasites of bark beetles also. Studies on spruce beetle in relation to logging slash indicate that some years slash may absorb and reduce a population, in that fewer beetles are produced than entered. However, a potential for an 8-fold increase in slash exists, so under some conditions it may greatly increase the beetle populations. Regarding ambrosia beetles, felling date is quite important in determining log hazard, but it is hard to change logging practice in this regard. Clean and fast logging does help by reducing breeding material. Pulp mill availability may result in more intensive silviculture and cleaner logging by providing a market for material that otherwise would be left. Nonchemical control methods are mostly unproven. More intensive forest management may aid pest control in the future.

Conclusions

The ecosystem approach is needed, but is barely beginning. The ecosystem approach, of course, includes man as a component. The "problems" originate with man. The forest pest picture is very complex biologically. There is hardly any thorough analysis of any biological control agent, let alone of their total effect. Scientific knowledge to use in this approach is still meager. In addition there are many "political" barriers to applying what knowledge there is. For example, strip culture of alfalfa would reduce the problem of Lygus bugs, but inertia of growers to new practice is a barrier. Another example is logging vs. mill organization in lumber companies. This affects ambrosia beetle control by isolating logging practice from pressures to control, which operate at the mill output level. Research workers must recognize the human or "political" aspects of their problems. An important part of all problems is to "sell" sound knowledge when it is available. The role of Administrators is important here. They are the ones who can back up the sustained, careful studies needed for real progress in understanding, and they can play an important "political" role in backing rational and sound approaches.

SECRETARY'S REPORT OF WORKSHOP NO. 4
19TH WESTERN FOREST INSECT WORK CONFERENCE

Chairman: Rudd
Secretary: Lyon

The general content of workshop 4 was side effects of pesticide use. We could touch only briefly on a few aspects of this many-faceted subject in the scheduled time.

1. Our emphasis was contamination of the environment by pesticide residues and consequences of this contamination.

Scope: It is now well documented that we do have contamination of air, water, and soil on a global scale. And now there is evidence that pesticides may be carried great distances by trade winds. The major offenders, because of their chemical stability and persistence after application, are the chlorinated hydrocarbons and principally DDT and its degradation products.

Significance of these contaminants: The most significant consequence of these residues is that they accumulate in animal tissues and can be transported through food chains and build to high levels. It is not yet clear that the consequences of this "transferring effect" through biological systems are detrimental. But we see evidence building that some species of animal life may be threatened with extinction due to chemosterilizing effects or to major disruptions in the ecosystem or through effects that we do not yet know. At the same time, we recognized the difficulty in proving a cause - effect relationship between accumulations of pesticide residues in animal tissues and subsequent harmful effects to the organism and to society.

2. Other Side Effects:

Two other side effects of pesticide use were brought out: (1) Resurgence of the target insect after initial suppression by a pesticide; and (2) the change to major status of secondary or minor pests following an intensive chemical control regime. We were not able to persue these important problems to any extent. We did conclude that little is known about how troublesome they may potentially be. Yet, at the same time a number of the workshop members felt that the future will see an expansion in these kinds of effects if heavy dependence continues to be placed solely on chemical controls especially on the scale we now see in agriculture.

3. Exotic Chemicals:

We explored briefly the possibilities for reducing side effects by substituting exotic insect control chemicals for the conventional insecticides. Examples of these would be chemosterilants, hormones, pheromones, bacterial toxins, anti-feeding compounds, knockdown.

agents, disease stressors, synergists for naturally occurring plant chemicals and others. We discussed briefly, the first two chemosterilants and hormones.

We agreed it was premature to expect to reap the benefits of these new generation insect control chemicals soon. The state of our knowledge about them is simply not far enough along. And by the same token, the potential hazards from their use are also insufficiently well known at this time. We can expect that the new chemicals will have some of the same undesirable properties of conventional insecticides such as a broad spectrum of activity. They may however be less persistent and less toxic to man and wildlife.

We considered also the question: How thoroughly should we know the hazards (potential side effects) of a chemical before we put it to use on a practical scale? We did not reach a consensus. Some believed we should know the consequences of using a new chemical completely and fully before broadscale adoption. Others of us felt that we cannot practically know this, fully. The extreme difficulty of knowing all the ramifications of a chemical's use and, on top of this, the pressure of needs, make it unlikely that we could ever achieve a full prior knowledge of these ramifications.

4. Prophecy of the Future:

We attempted to prophesy about the future of pesticide use on forest lands and the adverse consequences of that use. Our logic led through a sequence of questions: (1) What will be the demands on forest lands? (2) How will Forest Management practices change? (3) What will be the pest problems? (4) And what pest control methods will be used?

As you might expect, we quickly found ourselves bogged down in deciding what the demands on forest lands will be and how these demands will affect management practices.

There was considerable support for the contention that the increasing competitiveness of aluminum and synthetic materials will lead more and more toward a forest management goal of producing fiber. We may therefore see more intensive management concentrated on smaller areas on good sites. A concentrated effort to get more output on smaller areas of level land of good quality. Mechanization will increase as in agriculture. Planting and fertilization will increase. Monocultures may predominate and complete utilization may mean the elimination of slash.

We could not all agree to this. So many factors that we cannot foresee may topple any reasoned set of predictions. For example, a nontree plant might compete with trees as a producer of fiber.

Nevertheless, whether "fiber orchards" are or are not in the cards, it was generally agreed there would remain large tracts of land which may never be intensively managed but would function much as they do today as watershed recreational lands and the like. Pest control problems on such lands may be released from economic considerations in part and artificial pest control activities may be necessary only under threat of destruction of the plant community.

On the question of future pest problems on intensively managed lands, we were in general agreement that they will change - new pests will arise and old ones may be expected to adapt to the new conditions, and exotic pests may be introduced.

We agreed the temptation will be strong on these lands, as on agricultural lands to lean heavily on chemical controls because of their promise of quick results, and the reliable short protection they afford.

We conclude on an optimistic note. There were a number of points brought out about forest pest control which portend a reversal in the wide scale application of persistent insecticides, in fact a reversal that is well under way now (the outlook on a world-wide basis is not as optimistic).

a. The federal committee on pest control now strongly discourages use of DDT and other chlorinates hydrocarbons on federal lands.

b. The use of BHC for ambrosia beetle control in log booms in Canada is being phased out.

c. The dosage of DDT used for spruce budworm control in Canada has been reduced and the Chemical Control Institute there is seeking a nonpersistent substitute for DDT.

d. The work of the IEP at Berkeley has shown that nonpersistent insecticides will control spruce budworm at as little as 6/100 lb/acre when applied with careful attention to drop size and atmospheric conditions during application.

e. The need for very high kills, above 95 or 98%, is coming into question. Perhaps a lower dose producing, 70 or 80% kill is enough in some cases, leaving a reservoir of the target pest that could support natural enemies.

There are probably other signs on the horizon that have not been mentioned that did not come up during the workshop.

Workshop #5

Western Forest Insect Work Conference

Secretary: Robert E. Stevens

The initial topic of this discussion was economic considerations involved in pest control decision making. Dr. Vaux, the discussion leader, set the framework by pointing out that resource management problems - of which pest control is one - are attacked in a 2-step general process:

A. Listing a reasonable number of alternative approaches.

B. Evaluating each one in the light of prevailing factors, and choosing the most favorable one as a course of action.

This process involves close working relationships between the land manager and the protection specialist. The land manager must specify his objectives and identify the kinds of action he is willing to take in different areas or parts of areas. For example, greater investments in protection or prevention might be justifiable in timber growing areas with high site indexes as opposed to low indexes.

The protection specialist needs to be able to indicate what the land manager can reasonably expect. For example, it would be useful for the land manager to know there is a 30% chance that insect X will occur in outbreak status 3 times during a crop rotation.

It was recognized that in most cases in the West neither the land manager nor the protection specialist is on solid ground in these kinds of predictions. The value of the crop at Y years in the future is extremely difficult to predict as are the chances for pest outbreaks.

Also it was recognized that political factors may sometimes outweigh biological and economic ones, and also that resource management policies are no better in this era of good communications than the public reaction to them.

The discussion broadened later in the session and a number of examples were brought out that illustrated the general considerations given above. All these supported the idea that close scrutiny of objectives is absolutely essential, that gaining further knowledge of pest population dynamics is imperative, and that all efforts toward these ends are likely worthwhile. It was concluded that wildland management - whatever the objective - is relatively risky business, and should be recognized as such.

Diseases as Factors Predisposing Ponderosa Pine to Bark Beetle Infestations

Fields W. Cobb, Jr.

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Diseases of forest trees have occasionally been implicated in the occurrence of bark beetle outbreaks. Yet, there have been few studies designed to adequately determine the significance of disease as a predisposing factor. Nor have there been studies to determine the effects of disease on host physiology as related to increased susceptibility to beetles. In 1965, a reasearch team which included D. L. Wood, R. W. Stark, L. E. Browne (entomologists), E. Zavarin (wood chemist), J. R. Parmeter, and P. R. Miller (plant pathologists) initiated studies to determine the importance of diseases in the population dynamics of bark beetles and, if important, how these diseases act to reduce host resistance to beetles.

We have chosen to concentrate upon two types of disease which affect ponderosa pine, one caused by root pathogenic fungi, the other by photochemical atmospheric pollution. Root diseases are often overlooked in assessing the cause of beetle epidemics because of difficulties in detection. However, observations by a number of researchers have indicated that these diseases may be important in predisposition. A study was made to determine the correlation between the occurrence of root disease and bark beetle infestation. Three areas in California, two with histories of serious, chronic outbreaks of bark beetles and one with a low beetle population, were investigated. All recently killed ponderosa pines detected in these areas, except those obviously predisposed or killed by fire, flooding, road construction, etc., and those in large group kills, were examined for evidence of beetle attack and infection by root pathogens. Whenever both beetles and root disease occurred in the same tree, the tree was closely examined for symptoms such as resinosis or advanced root decay which indicate fungus infection prior to beetle infestation. A comparable number of living trees, chosen at random in the general area of the dead trees, was also examined for evidence of root disease. The results are summarized below.

Boggs Mt. State Forest: Chronic bark beetle infestation. Approximately 60 dead trees were examined; 56% of the trees had severe root disease with subsequent beetle infestation, 42% of the trees were infested by beetles without detected disease, and 2% were apparently killed by root disease alone. Root disease was not detected in any of

the randomly selected living trees. The primary root pathogen was Fomes annosus, and the major insect was Dendroctonus brevicomis.

Blodgett Experimental Forest: Chronic bark beetle infestation. Approximately 95 dead trees were examined. Severe disease occurred in 79% of the trees prior to beetle infestation, disease was not detected in 20% of the beetle-infested trees, and only 1% had apparently been killed by disease alone. Again, root disease was not detected in any of the living trees. The primary disease organism was Verticicladiella wagenerii, and the major insect was D. brevicomis.

Quincy area (Plumas County): Low bark beetle population. Approximately 70 dead trees were examined over an area of 25,000-50,000 acres. Severe root disease occurring prior to beetle infestation was detected in only 9% of the trees; 91% were apparently killed by bark beetles alone; and no trees were killed by root disease alone. None of the living trees examined had severe root disease. The primary disease organism was F. annosus and the major insect was D. brevicomis.

Thus, root disease appears to be a major factor sustaining bark beetle populations in the first two areas. Also, low incidence of disease may be partially responsible for the low bark beetle populations observed in the third area. Studies on the effects of root diseases on host physiology have been initiated.

The second disease under study is "chlorotic decline" caused by photochemical atmospheric pollution. An investigation to determine the association between this disease and bark beetle infestation revealed that only 3.5% of 479 "healthy" trees were infested, whereas 6.3% of 383 moderately diseased trees, 18.8% of 112 severely diseased trees, and 46.0% of 98 very severely diseased trees were infested. Susceptibility to bark beetles obviously increases as disease severity increases, with most of the killed trees having severe disease symptoms prior to infestation. D. brevicomis and D. ponderosae were the major bark beetles encountered. D. ponderosae occurred only in diseased trees whereas D. brevicomis was able to infest some of the trees with less severe disease symptoms.

The effect of chlorotic decline on various factors related to host physiology was also studied. As the severity of disease increased:

1. Oleoresin exudation pressure progressively decreased.

2. Propensity of oleoresin to crystallize increased.

3. Beyond the intermediate stage, oleoresin yield and rate of flow decreased.

4. Oleoresin quality was apparently not affected.

5. Moisture content of both phloem and xylem was reduced.

6. Tree growth and live crown ratio were reduced.

7. Phloem thickness was reduced, but phloem pH was apparently not affected.

8. The amount of phloem sugars was reduced in the early stages, followed by reduction in other carbohydrates during later stages.

9. Both quantitative and qualitative changes in needle oils occurred.

Most of the above physiological changes which are associated with disease can be discussed in relation to current hypotheses on the mechanisms of host resistance to bark beetles.

Color aerial transparencies and probability sampling techniques estimate Douglas-fir beetle loss in northwestern California

R. C. Heller

The severe December 1964 storms and floods in northwestern California caused a vast amount of Douglas-fir trees to be damaged and uprooted. These downed trees provided a favorable habitat for normally quiescent Douglas-fir beetles (*Dendroctonus pseudotsugae* (Hopk.)) and permitted a tremendous buildup of beetle populations during 1965. They moved into live timber in 1966 and caused the worst epidemic ever recorded in California's history. It covered 1.6 million acres in Del Norte, Humboldt, Siskiyou, and Trinity Counties and represented an unprecedented loss of Douglas-fir trees.

How would one go about estimating the loss over so large an area? An administrative study was drawn up in May 1967 between Region 5 and the Pacific Southwest Forest and Range Experiment Station to estimate the tree mortality that occurred in 1966. Because of the large area involved and extreme inaccessibility, a sampling survey was designed using 9- by 9-inch color transparencies taken over randomly selected locations and coupled with ground checks.

The procedure is described briefly as follows. Based on 1966 aerial sketch mapping flights, the area was stratified into three damage levels--light, moderate, and heavy. Each damage level was sampled with aerial color transparencies to a different degree, e.g., in the light damage level, two randomly located flight lines were chosen within the first 12 miles and stereo triplets (3 overlapping color transparencies taken at a scale of 1:8,000) were photographed 12 miles apart. For the moderate stratification, two flight lines were within the first 9 miles and stereo triplets were 9 miles apart, and for the heavy, 6 miles was the interval. In any one strata, the sum of all photo triplets along alternate flight lines was considered a cluster; there were two clusters per stratification, each representing one half of the area in that strata.

The 318 aerial transparencies (Anscochrome D/200) were taken with K-17 cameras having 12-inch focal length lenses in late June 1967.

Following film processing, three photo interpreters were given training for identification of tree species and appearance of damage. They used Old Delft Scanning stereoscopes and completely examined the center photo of the stereo triplet--approximately one square mile. The interpreters circled in red ink each tree or group of trees suspected of being killed by the Douglas-fir beetle; they also counted and recorded the numbers of trees occurring within each infestation center. The interpretation took 25 man-days or about 2 work-weeks to examine all 106 triplets.

A special computer program was devised which takes advantage of the high correlation of photo interpreters to identify insect-killed trees (.97 in this study) and permits the estimate of the error to be based entirely on the selected ground checks. The selection of ground infestations was based on the probability of their being chosen proportional to the size (number of dead trees counted on the photos) of the infestation. This is a new concept. A minimum of two ground samples per cluster, or four per strata, was needed to compute the variance. The sampling design may be described as a two-stage cluster sample with random starts in the first stage and sampling proportional to size in the second stage. The design of the study was developed by Langley and Norrick and is being written up for publication in *Forest Science.*

The amount of money and number of men available determined that 53 ground samples could be examined. This took 98 man-days (19 men over an 8-day period) working in 2- to 3-man crews. Data taken on the ground included: bole diameter, height, cull, and the currently infested Douglas-fir trees around the periphery of the plot. Tree volumes were computed from available volume tables.

A summary of costs is shown in the following table:

Photo Plots		Ground Plots	
Aircraft	$1,024.00	Preparation of field maps	$204.00
Film, processing and editing	500.00	Cruising	3,332.00
Per diem - photo crew	150.00	Helicopter transportation	1,650.00
Photo crew salaries	600.00	Per diem - field crews	1,252.00
Interpretation	825.00	Miscellaneous	20.00
Miscellaneous (Computer use)	50.00		
Total cost	$3,149.00		$6,458.00
Number of plots	1,380		53
Cost per plot	$2.28		$121.85

Total Cost $9,607

Cost Per Acre $0.006

Results of the survey showed that the Douglas-fir beetle had caused mortality amounting to:

249,000 ± 13% 1/ trees killed

796,000 MBF ± 11% gross volume loss

535,000 MBF ± 10% net volume loss

The new sampling technique points out how much more efficient it is over other survey methods taken to the same intensity (4 percent) and within the same error of estimate (1 standard deviation). For example, if we were to conduct a line-strip (1 chain wide at 25-chain intervals) ground survey over the 1.6 million acres, it would require 17,000 man-days and $830,000. Aerial sketch mapping coupled with 190 ground visits would take 400 man-days and cost $21,200. In terms of cost benefit ratios, they would stack up as follows:

	Ratio
Variable probability sampling--air photos and 53 ground visits	1:1
Air observation and 190 ground visits	3:1
Line-strip ground survey	100:1

This new method looks particularly promising and efficient for bark beetle surveys because it takes advantage of sampling large areas for beetle damage on a photograph which is relatively inexpensive. The statistical technique is also adaptable to other kinds of bark beetle losses in other types of timber and terrain. The method points out that large amounts of stand information can be obtained at relatively little cost.

1/ At one standard deviation.

WESTERN FOREST INSECT WORK CONFERENCE

Workshop on interrelationships of bark beetles, microorganisms and host trees - S. J. Barras

The mycangia (fungus storage organs) of *Dendroctonus frontalis* and *D. brevicomis* were illustrated and compared. The *frontalis mycangium* is somewhat smaller than the *brevicomis* but the basic anatomy and morphology are the same. The *brevicomis* structure has a slightly larger opening.

Isolations from both mycangia show the presence of two microorganisms in each. The two from *frontalis* are very similar to the two from *brevicomis*. One microorganism is apparently a Basidiomycete and the other an Ascomycete. *Ceratocystis minor* the common blue-stain fungus associated with both insects has not been found in the mycangia.

A report was presented on some of the chemical changes observed in loblolly pine phloem as a result of the development of the *D. frontalis* microorganism association and the individual development of *C. minor* and a mycangial fungus. In general it was found that none of the treatments resulted in a reduction in starch content. Both reducing and nonreducing sugars were greatly decreased by all treatments. Storage of intact phloem alone resulted in some decrease of nonreducing sugar.

There appears to be at least 34 free amino acids in inner bark of loblolly pine and twenty of these also were present in the protein fraction. Glucosamine occurred in all treated bolts but not in the control bolts, indicating that it is a component of proteins of the microorganisms but not of the tree. In general free amino acids were markedly reduced and protein amino acids increased.

It appeared that both microorganisms, and the beetle-microorganism association are able to utilize almost all the free amino acids either directly or through transformations. The net result is an increase in the protein or insoluble N fraction.

Report by Chapman -

It was reported that Farris is investigating the location of mycangia in various ambrosia beetles and *Ips*. Funk is working on polymorphism in ambrosia fungi. Schneider from Germany is also investigating mycangia in ambrosia beetles.

Vertebrate Predation

by

Paul H. Baldwin

Several predator-prey systems involving vertebrate predators and forest insect prey have been studied in the United States and Canada. Important predators may be either mammals or birds. Research on the predation by shrews of sawflies and on the predation by various birds of the larch sawfly and the spruce budworm have been reviewed recently by Buckner (1966, Annual Review of Entomology). Considerable work done in the 1950's and 1960's on the predation by woodpeckers and other birds on the bark beetles, such as the Engelmann spruce beetle, Dendroctonus obesus (Mann.), has not been summarized or reviewed recently. Since this predator-prey system is an important one in the subalpine and boreal forests, recent work with woodpeckers and with insectivorous perching birds at spruce beetle infestations will be presented as a basis for discussion at this workshop.

Before we can progress toward an understanding of the bird and bark beetle interrelations, it is necessary to know about the characteristics of the principal organisms. Research since the early 1940's has resulted in much knowledge about the life history and population dynamics of the Engelmann spruce beetle. More recently the feeding ecology of the woodpeckers in subalpine forests has been studied. We still need further work on the predator-prey relationships of woodpeckers and other vertebrate predators on the bark beetles. We especially need to know about the types and magnitudes of interactions among factors that affect the activities and survival of both predators and prey.

Spruce beetle infestations in Colorado were of catastrophic magnitude in the 1940's and early 1950's but they subsided after 1951. Since that time, local epidemics of low level have continued to occur. Typically, the latter start in blowdowns or logging culls and persist through a few generations before diminishing to endemic populations under the influence of several mortality factors.

Life tables have been prepared for the Engelmann spruce beetle by Knight (unpublished, Rocky Mountain Forest and Range Experiment Station). These are average life tables based on sampling done over a number of years at 15 infestations. They serve to show that predation by woodpeckers usually causes large percentages of mortality during the time of brood development. They also indicate that moderate mortality (average about 33 percent) probably occurs during the flight stage prior to attack.

The numerical responses of northern three-toed, hairy, and downy woodpeckers have been studied at both low and moderate epidemic infestations. Results indicate that, initially, resident birds concentrate in autumn and winter by drift and aggregation in areas having trees with abundant beetles. If the number of prey are fairly limited, the birds remain until the prey become depleted to previous endemic levels, and then the birds will redistribute themselves to their former densities (Koplin).

If the prey are quite abundant, the woodpeckers will remain in the area and nest, decreasing the size of their nesting territories. At the termination of the breeding season, nesting territoriality breaks down and the birds plus their broods concentrate on the prey. If the beetles persist through successive breeding seasons, the woodpeckers will continue to nest in the area, but not beyond a maximal nesting density, which so far has been observed to be seven pairs of woodpeckers per square mile of spruce-fir forest as against less than one pair per square mile in forest with endemic spruce beetle populations. The responses differ among the three woodpecker species; the northern three-toed woodpecker is the most consistently present throughout the infestation; the hairy builds up rapidly but leaves earlier in the declining phase; the downy typically aggregates at the infestation for feeding only in the winter.

The functional responses of woodpeckers may be assessed in terms of the amount of feeding they do at infested trees with different densities of spruce beetle brood. The percent of mortality caused by woodpecker feeding is greater in trees supporting dense prey populations, rising to 98 percent and less in trees with sparse prey where it remains about 45 percent (Knight). Also the mortality may be assessed in terms of the whole infestation, and with heavy woodpecker feeding the overall mortality has been estimated as from 50 to 75 percent.

Another assessment of functional response is based on the analysis of stomach contents of birds feeding at the infestations. Woodpeckers feeding at new catastrophic infestations in the winter of 1950 had spruce beetles in the stomachs to the extent of 99 percent of all foods represented (Hutchison). In the summers, during the late 1940's, the mean content of spruce beetle in the foods was about 65 percent (Massey and Wygant). Later, in the 1950's at older, low level epidemics the mean proportion of spruce beetle was never as high as 99 percent, and in summer the spruce beetle averaged about 30 percent. Northern three-toed and hairy woodpeckers both consumed more spruce beetles in forests supporting epidemic populations (28 and 17 percent) of beetle than in forests supporting endemic populations (7 and 2 percent).

At initial phases of catastrophic infestations, few secondary beetles may be available resulting in higher percentages of spruce beetles in the stomachs. At smaller infestations where buildup is gradual, the trees attacked earlier contain a variety of secondary bark beetles and wood borers that divert the woodpeckers from feeding on spruce beetle brood. In summer, feeding is spread over a greater variety of resources than in winter.

Proportions of beetles in the diet of the birds can be converted to amounts of beetle removed from the environment if the daily intake of food can be estimated as kilocalories. Such estimates are possible with the use of equations developed in studies of energy exchanges during metabolism of birds. If the sizes of the local spruce beetle population and the predator populations are known, percentage reduction of the total population of beetles as a consequence of avian predation can be estimated.

Alternative predators prey on the adult beetles during the stages of flight and attack. In a preliminary study on the San Isabel National Forest, insectivorous perching birds of several species participated in predation of spruce beetle in the summer period. Ninety percent of individual birds were involved in eating amounts of beetle that averaged 5.2 beetles per stomach analyzed. The following summer, with lower beetle population, about 50 percent of individual birds had taken the insects, with an average of 1.5 beetles per stomach. From an estimate made of the beetle population, it appeared that about 24 percent of the flying adults were eaten by the birds in the first of these two summers.

In the same study, olive-sided flycatchers (as individual birds) ate most beetles, as 34 percent of their food consisted of spruce beetle adults. However, mountain chickadees were much more abundant in the area and, although eating only 17 percent of spruce beetle, they accounted for the mortality of a larger number of the beetles.

A study of avian predation on the flight stage of the Black Hills beetle, _D. ponderosae_ Hopk., resulted in an estimate that about 10 percent of the flying adults were removed by the various perching birds resident in the area of the local infestations (Stallcup).

In the declining phase of a low level epidemic spruce beetle population in the San Isabel National Forest, it was found that woodpeckers caused about 80 percent mortality to spruce beetle brood developing in wind-thrown spruce trees. It frequently has been stated that woodpeckers are ineffective at blowdowns, but now it appears that this would hold true where ample brood is available to woodpeckers in standing trees but not necessarily in late stages of the infestation with augmented numbers of woodpeckers when the new attacks are limited to blowdowns. Thus, woodpeckers may hasten the decline at the end of an epidemic by concentrating their attention upon beetles developing in windfallen trees.

The foraging activity of woodpeckers has a direct and an indirect effect on populations of the western pine beetle. The direct effect is reduction in beetle numbers through actual consumption. Indirect effects are byproducts of foraging activity of the woodpeckers, such as bark flakings, reduction of bark thickness, increased parasitism, somewhat reduced density of insect predators, and effect of climate on the bark beetle brood remaining in the "thinned" portion of the bark (Otvos).

Concerning vertebrate predation on other types of forest insects, recent study has indicated possible consequences to the birds from the use of sprayed-on chemicals. Fluorescent particles in Zectran spray formulations used in Montana in 1965 and 1966 permitted an assessment of relative

contamination of some insect food items of birds. Insects most immediately affected by spray and being pursued by birds tended to have heavier contamination. Most birds collected after spraying had spruce budworm remains in the alimentary tract but larger numbers were present in stomachs of golden-mantled ground squirrels and chipmunks. A chipmunk was observed foraging for spruce budworm larvae on an infested tree before spraying, and similar activity was observed for other chipmunks and a red squirrel (Pillmore). Spraying for insects during the nesting season of birds may knock off the food supply of the birds, forcing them to leave the area letting their young starve.

WORKSHOP: EVALUATION OF FOREST INSECT POPULATIONS

Moderator - W. E. Waters

Following general agreement by the approximately 40 participants that "evaluation" included consideration of economic and social factors in addition to the biological ones, the moderator outlined the steps or components comprising a complete evaluation of a forest insect population:

I. Initial observation of abnormal tree growth or injury, or the presence of noticeable numbers of a potentially injurious insect.

II. Identification and verification of the insect involved.

III. Assessment of current degree and extent of damage, if any.

IV. Estimation of the relative abundance of the pest and its variability in numbers.

V. Prediction of trend in pest population and probable effects on host trees--with or without applied control.

VI. Consideration and estimation of (a) economic and social values at stake, (b) probable cost of control by method most feasible and/or applicable, and (c) all other socio-economic factors known or thought to bear upon the particular situation.

It was quickly agreed that steps I and II are now handled routinely, and subsequent discussion focused upon the latter four steps of evaluation.

Many participants criticized the widespread practice of merely rating damage as light, medium, or heavy, mainly because such categories seldom have relevance to economic thresholds of damage. Discussion then dealt with damage thresholds, and it was generally agreed that the lack of well-defined damage thresholds for most forest situations poses a major obstacle to adequate evaluation. A few people suggested that, even if damage thresholds were known for various kinds of forest situations, management objectives in many cases are so vague and in other cases so subject to change that often the evaluating entomologists may not know which particular damage threshold is applicable. Most participants agreed, however, that evaluations could be much improved by obtaining greater knowledge about the ecological impact of insect infestations.

On the estimation of pest numbers and their variability, the moderator pointed out that the sampling method and plan frequently are not distinguished from survey procedure and plan. Several examples were cited where a good sampling method is available, but is of little use to pest control people simply because an adequate survey procedure has not been developed. The moderator also briefly discussed some "new" sampling methods for classifying or estimating insect densities and related population characteristics. These included nonparametric or distance measures, such as those based on the random pairs and nearest neighbor ideas, and sequential methods. The participants were much interested in the method of inverse sequential sampling because of its usefulness in sampling endemic populations.

Many people agreed that prediction of insect population trend was the weakest part of current evaluations, and that this weakness arises mainly from the lack of knowledge about endemic populations. Some people were optimistic that predictions would be improved in the near future as results become available from current population dynamics studies. Others indicated they were not so hopeful, because the current population study effort is small compared to what is needed and is focused too much upon epidemic populations. Relief of the general problem of predicting population trend probably will not be forthcoming until long-term population studies become the rule rather than the exception. Relative to predicting probable damage, it was recognized that very little effort has so far been made to understand the relationship between insect population trend and damage trend. Here, as in so many areas of study relating to evaluations, much work is needed.

There was virtually unanimous agreement that evaluations would become increasingly difficult in the near future. Greater investments in intensive forest practices and the increasing recreational use of forest lands will demand more accurate and more frequent evaluations, and will make the spectrum of considerations affecting evaluations much greater and more complex than now.

Population genetics of forest insects

Discussion leader: K. Graham

Advances being made in knowledge of population ecology give us reason to believe that genetic quality in insect population material should be considered more carefully by experimenters and field observers. While we sometimes concede that some of the heterogenity we find in population stock is due to genetic variability, we often miss its significance because it diverts our attention to the statistical nuisance rather than its biological implications. Population genetecists and ecologists tell us that populations, being heterogeneous, are therefore selectable under various selection pressures such as pesticides, climate, or competition; and consequently, the composition of population material as an average is not identical from place to place or time to time. It seems timely for us as forest entomologists to take a close look at the question of how genetic variability may affect our efforts to explain, predict, and manipulate insects.

How can the genetic factor affect our work? One consideration is that heterogeneity yields unequal responses among individuals of a population. We are already armed with statistical analyses to handle this along with other causes of heterogeneity.

A second consideration is that the "constitution" (however we decide to define this) of the average insect in a population may not be the same from one place to another or one time to another. Therefore, whole populations composed of these individuals will differ from place to place and time to time. If we do not allow for such average differences, we may wonder why we obtain different degrees of correlation between insect attack or abundance and other factors. For example, with bark beetles, can be hope to establish good correlations between susceptibility of trees to attack and various parameters of tree vigor when all the while the hereditary quality of the insect stock is not only changing but the changes are unsuspected and unknown? Recognition of a genetic difference in populations could conceivably strengthen rather than weaken the case for the parameters that various investigators have been seeking, such as root rots, OEP, etc.

A third consideration of the genetic factor in forest entomology is that it could provide one of the important clues to population rise or fall when other factors cannot alone account for outbreaks or their decline.

What evidence do we have which might give some credibility to genetic factors in rise or fall of insect (and other animal) numbers? Instances were cited of bark beetles failing to develop into outbreaks even when

conditions favorable to increase existed and when stands would be considered susceptible. On the other hand instances are known of Douglas-fir beetle flaring up into outbreaks which the usual factors did not seem to explain.

Why have we not generally allowed for the genetic factor?

The starting point for any study is logically one point in space and time. We then tend to think that a careful study has fully-characterized the species.

Ecologically significant differences between populations of a species are not apparent without specially designed tests.

Objective criteria of genetic differences have been difficult to define.

The statistical problem of genetic (and other) variability has diverted our attention.

Heretofore other factors have needed exploration, though ironically would have had more significance if we could have defined the genetic base more precisely.

Genetic studies have usually been done with convenient laboratory insects, so that attention of forest entomologists has not been drawn to the possible application to this field. There has been a communication gap.

How can we attack the problem? A new technique now makes possible an examination of genetic material at the molecular level of organization. Two workers in Chicago: Hubby and Lewontin (1966 Genetics 54: 577-594) and Lewontin and Hubby (Genetics 54: 595-609) have applied electrophoresis techniques to the study of genetically determined enzymes in insect tissues. It is possible thereby not only to characterize the genetic material of a population, but also to distinguish population differences. The technique is not difficult. We now do not have a legitimate excuse to ignore the subject where it may be important to allow for it.

Where could we start? Logically we might compare electrophoretically the enzymes of different population material at different times and places to establish whether the genetic material is different and changing. Also we could experimentally apply certain selection pressures that we might suppose are ecologically meaningful and test the resultant populations both electrophoretically and by such criteria as fecundity and survival. At least the technique should be used to characterize the genetic material with which we are working in other studies. This is perhaps as important as putting the species label on it.

Forest Insect Pheromones

D. L. Wood

The discussions on this subject were concerned with the following:

A. P. S. Callahan's theory on the olfactory guidance of moths.

1. Moths respond to the emitted infrared radiation specific for each chemical attractant; the attractant molecule therefore does not have to be in contact with the sensillum to evoke the response.

2. The technology necessary to produce the specific infrared spectrum of a molecule in an attempt to stimulate the olfactory receptors in the absence of the molecule does not appear to be available at the present time.

3. Wingbeat activity can be stimulated not only by the chemical attractant but also by other odors, light, and heat. The clasper response of the male is the only behavioral component which is elicited specifically by the pheromone.

B. The presence of pheromones has been established for the following forest defoliators:

1. Spruce budworm
2. Carpenterworm
3. Lodgepole needle miner
4. Introduced pine sawfly
5. Douglas-fir tussock moth
6. European pine shoot moth

C. Many forest insects probably respond to host odors, but this important area of forest insect research has received very little attention. The evidence for such host selection behavior was discussed with particular reference to the Scolytidae, Buprestidae, Cerambycidae, and Lepidoptera.

D. Bark Beetle Pheromones.

1. _Trypodendron lineatum._ The tremendous dollar losses caused by this insect especially in the British Columbia export market was discussed in detail. Protective sprays of BHC have been applied to log booms for eight years, but residues are now being detected in trout and oysters. Methyl Trithion is now replacing BHC. Systemics which are translocated into the bark was suggested as a possible alternative to prophylactic sprays. The importance of identifying and synthesizing both the host and insect-produced attractants

and their possible use as a new approach to population suppression was discussed. The collaborative effort between R. M. Silverstein, Stanford Research Institute, and J. H. Borden, Simon Fraser University, to identify these compounds was described. J. H. Rudinsky, Oregon State University, is also engaged in a similar effort.

2. Dendroctonus pseudotsugae. J. H. Rudinsky is studying host attractants and R. M. Silverstein and J. H. Borden are attempting to identify the pheromone(s) produced by this bark beetle.

3. Dendroctonus frontalis. J. P. Vité and co-workers have developed the "trap spot" method of manipulating southern pine beetle populations in east Texas. Female infested bolts direct the population to preselected trees near roads where they can be felled and treated following the attack phase. The size of the "trap spot" is regulated by spraying a band of standing trees at variable distances around the trees "marked" for attack. Identification of the pheromone(s) is not being emphasized. Progress in identification of these compounds at the University of Georgia was unknown.

4. Dendroctonus ponderosae. G. B. Pitman, Boyce Thompson Institute, described the "trap spot" method for manipulating populations of this bark beetle in the western white pine region of Idaho. The Boyce Thompson Institute in collaboration with G. W. Kinzer, a chemist with the Battel Memorial Institute, Columbus, Ohio, are attempting to identify the pheromone(s) produced by this insect. R. M. Silverstein, D. L. Wood, and W. F. McCambridge, Rocky Mountain Forest and Range Experiment Station, U. S. Forest Service, are investigating the chemical nature of the pheromones produced by this bark beetle attacking sugar pine in California and ponderosa pine in the Black Hills.

5. Dendroctonus brevicomis. D. L. Wood and R. M. Silverstein outlined recent studies of the western pine beetle pheromone and the identification and synthesis of "brevicomin," thought to be the principal component of this insect's secondary attractant.

6. Ips confusus. W. D. Bedard and D. L. Wood described recent field studies which verify the activity of the three synthetic terpene alcohols isolated and identified from male frass.

POSSIBILITIES OF INTEGRATED CONTROL OF THE SPRUCE BUDWORM SPECIES COMPLEX (CHORISTONEURA SP.)

Workshop Discussion Leader: Carroll Williams

We reiterated Dr. R. H. Smith's definition of Integrated Control as--an ecological approach to pest control.

We then proceeded to discuss the effectiveness of various biological, silvicultural, and chemical procedures that could be used singly and in combination to suppress spruce budworm populations below economic levels of damage.

One of the most obvious needs in considering possible control programs is first of all defining the economic levels of damage. This is very difficult to do for forest stands. The point where varying levels of damage become economic is strongly dependent on the resources and our changing economics--forest economies vary with forest types and locations. Economic levels are also dependent on variations in consumer demands and the difficulties of measuring the impact of insects on yield and quality of the resource.

Generally chemical control (which is the main control procedure used on spruce budworm) was considered when the spruce budworm population trend was level or up, and tree mortality would occur if defoliation continued at similar or higher levels. Mostly we are dependent on the educated guesses of experienced field entomologists.

Pest Biology and Population Dynamics

Implicit in any ecological approach to pest control is knowledge of the biology and population dynamics of the pest itself:

1. The spruce budworm species complex is widely distributed in North America with representatives in many different forest types. It has been divided by T. N. Freeman into five species whose major hosts are spruce, true firs, and Douglas-firs. Budworms feeding mainly on pines were also described as various species.

2. The spruce budworm, *Choristoneura fumiferana* (Clemens) is the most widely studied forest defoliating insect pest in North America. A large proportion of some of the most classic work in forest entomology has been done on this insect.

a. A substantial amount of information exists on epidemic population dynamics of C. fumiferana in a few forest types. The majority of Canadian and American studies has been on epidemic populations of this insect in eastern North American balsam fir-white spruce forests.

Studies are needed on other Choristoneura species in other forest types. Additional studies on the two-year budworm C. biennis in the Canadian Rockies, C pinus pinus in the Lake States, and C. occidentalis populations in Idaho, Montana, and the Pacific Northwest are necessary.

b. There is very little published information on endemic population dynamics of spruce budworm in any forest types. Biotic factors may be more effective in regulating low or endemic budworm populations than dense budworm populations.

We discussed in a general manner the environmental factors that seemed to permit outbreaks of the eastern spruce budworm (C. fumiferana) and the western budworm (C. occidentalis)

1. Dense populations of C. fumiferana are associated with flowering of balsam fir, large areas of essentially pure balsam fir, mature and overmature balsam fir in mixed stands. White, red, and black spruce are also hosts. Spruce budworm larval development may be more rapid on white spruce than on balsam fir.

2. C. occidentalis primary hosts are true firs, Douglas-fir and Engelmann spruce larval development rates and densities appear higher on true firs than on other host species in the same stand. Population dynamic of C. occidentalis on true firs may be analogous to that of C. fumiferana populations on balsam fir.

Budworm susceptible forests are increasing in Western States due to forest succession from pine to firs in the absence of fires.

Hot dry weather is the key factor in large budworm outbreaks. Hot dry weather increases flowering in balsam fir trees over large areas, thereby resulting in optimum food and shelter for small budworm larvae. Budworm development, feeding activity, and survival is greater during hot dry weather. Any forest type and stand structure that allows high evaporation rates and increases crown exposure favors local survival of large budworm larvae regardless of regional weather.

It is desirable to identify, evaluate, and manage epicenters or reservoirs of pest populations, particularly when they are small in relation to the total potential infested area. Identification of epicenters has been done from time to time:

1. Lake Nipigon, Ontario - the area from which the huge outbreak during the early part of this century originated and gained momentum. A mature balsam fir stand is now present.

2. Colorado Pass - Clearwater area Idaho - Montana. Budworm populations on fir sprayed five times to no avail as populations regained epidemic status within two years following each spraying.

3. True fir concentrations in the Wallowa Mountain Ranges of eastern Oregon were the epicenters from which the 1945-55 budworm outbreak spread in Wallowa County.

Silvicultural Procedures

One of the procedures we may employ in manipulating the environment to make it less conducive to budworm population buildup is forest cutting. We usually call this procedure silvicultural control. The following might be attempted using this procedure. Many of the suggestions for "Eastern North America" are well documented in the literature.

A. Eastern North America

   1. Reduction of balsam fir complement in forest stand. Encourage less budworm susceptible conifers and some hardwoods to achieve diversified forest types thereby breaking up continuous canopies of balsam fir.

   2. Cutting large overmature trees, and plan short rotations for pure balsam fir stands and mixed fir spruce stands. The cutting units should be kept small (40-60 acres) and arranged to attain a diversification in age classes between adjacent units in succeeding balsam fir forest stands.

B. Western North America

   1. Reduction of the true fir complement in all budworm populated forest stands.

   2. Cutting Douglas-fir and burning cutting units to favor Ponderosa pine over all firs.

Patch clearcutting with cutting units kept as small as practicable should be used to increase first and second instar budworm dispersal losses.

The highest mortality of the generation occurs during these dispersal periods. During dispersal periods, larvae are more likely to land on host trees in a dense stand than in an open stand.

Biological Procedures

We spent much of the time on biological control discussing the density-dependent relationships between hosts and parasites. I think we recognized that the behavior or action of parasites, predators and disease organisms is such that we can only get partial control of pest populations. Full control is a biological rarity.

Parasites, predators, and disease do not appear capable of suppressing epidemic spruce budworm populations. However, some of these agents may be more effective at low or endemic budworm population levels. Our ignorance of endemic budworm population dynamics and consequently our need for additional work is again illustrated.

It may be possible to increase the complement of the seemingly ineffective natural enemies of the budworm. Perhaps some of the potentially more effective parasites are regulated by alternate hosts. Regardless of present levels of knowledge on parasites and predators - insecticide application, if possible, should be timed to avoid periods when the parasites are emerging and flying. Chemical procedures must be used in a manner that is least disruptive to biological control of actual and potential pests.

Chemical Procedure

Insecticides have been the main control procedure used in our attempts to suppress spruce budworm populations.

The spruce budworm is the most destructive forest defoliating pest in North America. As a result, more acres of budworm-infested forests have been sprayed than for any other defoliating pest.

Since 1949, tree mortality resulting from spruce budworm outbreaks has been reduced through extensive aerial spraying programs using various formulations of DDT on budworm-infested forests in the United States and Canada. Decisions to use this direct control method are based on considerations of:

1. the current effectiveness of natural control factors;

2. the amount and nature of damage caused and expected; and

3. the economic values at stake. These values are difficult to determine.

Although generally good direct control of _C. occidentalis_ population has been obtained by aerial application of DDT at an average cost of $1.00 per acre, widespread concern has grown over the adverse effects of residual DDT against nontarget organisms. This concern prompted some federal agencies to discourage and frequently to ban the application of DDT on Federal forest lands. Also there was evidence that spruce budworm populations in New Brunswick were developing resistance to DDT.

Programs were set up to seek safer, more specific, and less persistent insecticides to replace the wide spectrum, environmentally persistent DDT.

Some of the insecticides - DDD, Korlan, Sevin, and Malathion were not as effective as DDT against the budworm at similar dosage levels. Phosphamidon is effective against the budworm and is only one-fortieth as toxic as DDT to young Atlantic and Pacific salmon. But it is extremely toxic to birds. Laboratory and field tests show that one of the most promising insecticides for budworm control is a carbamate called Zectran. Zectran appears to have many of the characteristics sought in the basic chemical. It is much more toxic to spruce budworm than DDT, hence it can be applied in small amounts not hazardous to other forms of life. Zectran is especially safe to fish, birds, and small mammals. It is also nonpersistent, breaking down in sunlight within a few hours.

We realized that our application procedures must be reevaluated and updated. Target selectivity and percent mortality can be increased by the manner the insecticide is applied.

First of all it is realized that most of the insecticide applied in past programs was wasted in large drops which did not hit the budworm but contaminated the environment.

Recent research shows that droplets below 50 micron are most effective in causing budworm mortality, about 97 percent of the droplets found on dead larvae in field tests were below 50 microns. Spray equipment has been developed to produce droplets below the 110 micron size.

Secondly, these small droplets are carried to the budworm larvae by atmospheric transport and diffusion much more than the larger droplets which are more apt to be filtered out by the forest canopies. Strict attention must be paid to normal diurnal wind patterns in the drainages to be sprayed in order for the cloud of insecticide to be more accurately directed to the target insects.

Thirdly, budworms parasitized by the overwintering parasites, _Apantales_ sp. and _Glypta_ sp., survive the applications of Zectran (also DDT) proportionately better than unparasitized budworm larvae and larvae

parasitized by other parasites. Consequently, the incidence of parasitization expressed as the number of parasites per 100 budworm larvae increases after the insecticide application.

Fourthly, field tests have shown that Zectran is relatively specific in its action by reducing budworm populations to a much greater extent than most populations of insects associated with it in tree crowns. We have differential mortality that favors nonpest insects.

Conclusions

It may be possible through integrating various control procedures to keep budworm populations below the economic level by:

1. Reducing or converting budworm susceptible forest types through logging and control of species composition by logging and burning.

2. Attaining a diversification of species and age classes to reduce the component of susceptible species and age groups in the stands. The frequency of budworm outbreaks in an area may thereby be reduced.

3. Judicious use should be made of a nonpersistent relatively specific insecticide on budworm outbreaks that do occur to increase the incidence of parasitism in the budworm population yet not decrease the populations of alternate hosts of the parasites in the environment proportionately more than the budworm. This type of development should increase the parasite pressure on the next budworm generation and hopefully this situation would endure for several budworm generations.

   Identification of those areas where the pest-parasite ratio is unfavorable and proper timing of chemical application is important.

Perhaps through integrated control it no longer would be necessary or even desirable to achieve a high percentage mortality of the pest population as is really the goal in chemical control. We may be satisfied with a mortality of 70 percent or lower so that we do not disrupt but perhaps enhance biological control action where the pest-parasite ratio is unfavorable. A high mortality percentage is not important *per se*, but a residual population regulated or suppressed below the economic damage level should be the goal.

Notes on workshop session on "Aids in Decision-Making in Forest Insect Control." Moderator: C. J. DeMars

About 20 people attended this session which had three guest panelists: Dr. Ernst Valfer, Management Systems Research, Pacific Southwest Station; Dr. Louis Falcon, cotton insect control, University of California, Berkeley; and Mrs. Nancy Norick, biostatistician, Pacific Southwest Station.

The general line of discussion was structured to follow Dean Vaux's systems approach to forest management, including a consideration of the human and administrative problems involved:

1. Specifications of the problem; insect population levels, stand impact, control methods recommended.

2. Division of labor between forest entomologist and forest managers; responsibilities of each.

3. Limits on the applicability of science and economics to provide answers; when do we have to make our decision; go to work and trust to luck?

During the workshop session the need for incorporation of insect trend data and impact information into the regular Timber Survey Programs of the U. S. and Canadian Forest Services was stressed. The problem of adding trend data, as well as stand and edaphic data, on each site, using the Canadian Insect Survey system, was discussed. The computer-based system used by the U. S. Forest Service for forest inventory data processing also appeared to have shortcomings for intensive forest insect population work.

Dr. Valfer discussed various computer-based programs, including Elliot Amidon's MIADS2*, which could be used for recording data by point or area.

Dr. Falcon discussed the current integrated control approach used in cotton pest management. Extensive data have been collected, but no systematic computer-based program has been developed to handle these data.

Mrs. Norick discussed the pros and cons of generalized versus specialized computer programs for statistical analysis of field data.

The topic of mathematical models was briefly touched upon, but little new work in this vital field was reported at this work conference.

*MIADS2, an alphanumeric map information assembly and display system for a large computer. U. S. Forest Service Research Paper PSW-38. 1966.

Operational Aspects of Pest Management

Leader: Galen C. Trostle
Secretary: Paul E. Buffam

One of the major concerns of the pest control entomologists was "Where will we get the highly trained control specialists for future control projects that use the newer, more precise control methods such as the mist-sized droplets and specialized application equipment?" It was noted that the Chemical Control Research Institute of the Canadian Department of Forestry trains field personnel in Canada when needed. Evidently the Insecticide Evaluation Project at Berkeley will have trained personnel on some projects, but to what extent was not know.

Entomologists on the west coast of the United States are trying to alleviate their bark beetle problems through silvicultural approaches. The Forest Service in California is trying to develop a market for beetle-infested trees, but is finding a problem selling the trees because of public attitude against blue stain in lumber. Weyerhauser Company and the Washington Department of Natural Resources are attempting to lessen the Douglas-fir beetle problem through salvage. The Forest Service in Oregon has lessened their western pine beetle problems by removing high risk ponderosa pines.

It was mentioned that a land manager often has an alarmist attitude towards insect outbreaks - control, or else the entire forest will be destroyed. However, the forest entomologist seldom has the background information available to be able to forecast what might happen to a stand infested by a particular insect.

It was agreed that we need results of more impact studies such as that done by Boyd Wickman on the Douglas-fir tussock moth. Boyd emphasized that land managers should consider insect-caused growth loss as a major factor in the effect of an insect outbreak on a stand, especially if the stand is being managed for maximum timber production.

We adjourned with the thought that the forest entomologist serves to make recommendations to the land manager, so that he will have the information needed to more effectively manage his land. The forest entomologist's job is <u>not</u> to <u>tell</u> the land manager what to do.

MINUTES OF FINAL BUSINESS MEETING

March 7, 1968

The meeting was called to order by Chairman Washburn at 1:00 p.m. followed by the introduction of Paul Keen and John Mahoney who had been unable to attend our initial business meeting.

Minutes

The minutes of the opening business meeting were read. Paul Lauterback moved that the minutes be approved as corrected by Ralph Hall, the motion was seconded by George Downing and approved by the members.

1970 Meeting Site

Suggested sites were: Moscow or Missoula by Shank and Berryman, Portland by McComb.

Sartwell and Koerber moved and seconded that the meeting be held in the Moscow-Missoula area. The motion was voted by the members and so ordered.

1969 Meeting Discussion

A motion was presented by DeMars and Dyer and accepted to allow the theme to be determined by the local arrangements committee. It was suggested by the Chairman that the Chairman-elect consider a revision of the Constitution Reports of Committees.

Common Names Committee

It was moved and seconded by Wood and Bedard to accept the report as presented.

Ethical Practices Committee - by Ken Graham

The new chairman duly elected was presented with the items signifying the authority of his office.

Nominating Committee

Ken Graham presented the committees nominations.

Hall and Buffam moved that the nominations be closed and that the recommended slate presented by nominating committee be accepted by a unaminous vote. The motion was carried accepting the following offices:

Chairman - Dave Dyer

Secretary-Treasuerer - Les McMullen

Director - Paul Lauterback

Dave Wood and Bill Bedard offered their gratitude and thanks to the members of the conference who participated and in particular to those who acted as discussion leaders and recorders.

Wood recognized the time and efforts of Don Dahlsten towards the success of the conference.

The Chair was turned over to Chairman-elect Dyer who extended his thanks as spokesman for the conference for the efforts of the out-going officers.

The meeting was adjourned at 1:50 p.m.

MINUTES OF EXECUTIVE COMMITTEE MEETING

March 3, 1968

The meeting was called to order by the Chairman, Richard Washburn, at 8:30 p.m.

Present were:

Councilors: Bob Stevens, John Chansler, Les McMullen.

Chairman: Richard Washburn.

Secretary-Treasurer: Galen Trostle.

Program Chairman: Dave Wood.

Local Arrangement Chairman: Bill Bedard.

The minutes of the Executive Meeting of February 27, 1967, were read and approved.

The treasurer's report was submitted and approved.

Stevens moved that the Registration fee for the current meeting be set at $6.00 and $3.00 for students. It was so ordered.

Theme for the 1969 meeting was to be left to the option of the Program Chairman.

A discussion was held regarding the location of the 1970 meeting. It was the consensus of the committee that they would favor a location in the Moscow-Missoula area if an invitation is forthcoming.

The chairman discussed his choice for a nominating committee and the offices being vacated.

Bedard and Wood described the program and arrangements and encouraged all members to be full participants.

McMullen and Bedard moved and seconded a motion to adjourn. It was so ordered by the chairman at 10:10 p.m.

MINUTES OF THE MEETING ON COMMON NAMES OF WESTERN FOREST INSECTS

10:00 a.m. March 6, 1968, Berkeley, California

1. Background: At its Denver meeting in 1965, the WFIWC declared a 5-year moratorium on common names of *Dendroctonus*, beginning from Wood's revision of this genus in June 1963. It was hoped that the biological validity of the revision would be tested during that period. The moratorium expires in June 1968.

   a. During the past year the common names committee was asked to act on the assignment of common names to *Dendroctonus ponderosae* and *D. obesus*. This request was made by R. L. Furniss who is presently revising the USDA Misc. Publ. 273.

   b. Further, Charles Sartwell, Jr., proposed the common name "Mountain Pine Beetle" for *D. ponderosae* and opposed the common name "Spruce Beetle" for *D. obesus*.

2. After considerable discussion the Committee proposed the following common names:

   a. "Mountain Pine Beetle" for *D. ponderosae*. Prior to this proposal the common names "Black Hills Beetle" and "Northwestern Pine Beetle" were also considered. The latter two common names were rejected on the basis of their geographical restrictiveness.

   b. "Jeffrey Pine Beetle" for *D. jeffreyi*. Work done by R. H. Smith and by G. Lanier and D. L. Wood shows that *D. jeffreyi* is a valid species and the committee agreed that this beetle should retain its old accepted common name because of its host specificity.

   c. "Spruce Beetle" for *D. obesus*. Prior to the proposal of this common name the Committee considered the following alternate names: "Northern Spruce Beetle" (Graham and Knight, Principles of Forest Entomology, 4th edition), "Sitka-Spruce Beetle," "North American Spruce Beetle," and "Mannerheim's Spruce Beetle." These alternate names were rejected for various reasons.

3. The Committee proposed the delection of the presently approved common names of the following species of *Dendroctonus* now in synonymy by reason of Wood's revision:

Arizona pine beetle	for *Dendroctonus arizonicus* Hopkins
Southwestern pine beetle	D. *barberi* Hopkins
Alaska spruce beetle	D. *borealis* Hopkins
Roundheaded pine beetle	D. *convexifrons* Hopkins
Engelmann spruce beetle	D. *engelmanni* Hopkins
Smaller Mexican pine beetle	D. *mexicanus* Hopkins
Sitka spruce beetle	D. *obesus* (Mannerheim)
Eastern spruce beetle	D. *piceaperda* Hopkins
Black Hills beetle	D. *ponderosae* Hopkins
Red-winged pine beetle	D. *rufipennis* (Kirby)

4. The Committee appointed D. L. Dalhsten to its membership to replace D. L. Wood whose term expires in 1968.

5. The Committee instructed its chairman to submit the above given proposals to the E. S. A. Common Names Committee.

The meeting adjourned at 11:15 a.m.

COMMITTEE ON COMMON NAMES OF WESTERN

FOREST INSECTS

D. A. Pierce, Washington D.C. (1969)

D. L. Wood, Berkeley, California (1968)

D. A. Schmiege, Juneau, Alaska (1969)

M. M. Furniss, Moscow, Idaho (1971)

J. A. Schenk, Moscow, Idaho (1971)

L. H. McMullen, Victoria, B. C. (1971)

L. Safranyik, (for R. E. Stevenson) (1970)

REPORT OF THE ETHICAL PRACTICES COMMITTEE
for 1967-1968

The ethical practices committee, the EPC, now being well into the second decade of its existence, has strived for the past year to continue its vigilance to uphold the traditions of this now hoary institution.

Now, whereas, the burden of this sober office has weighed heavily on the active members as well as the alumni of this institution,

and, whereas, their heads are bloodied, though unbowed, in their struggle to uphold the traditions,

and, whereas, tradition holds that it is the further responsibility of this committee to designate its successors and to

and whereas, in the event that a worthy successor to this office is not found, the EP Committee shall be empowered to withhold the transfer of office.

However, inasmuch as we have in our midst a loyal upholder of the traditions of this office, who has been consistent throughout the years, and has on numerous occasions shown qualities of star performance, it is due time that this candidate receive the recognition that he merits. Not only has he shown his keen perceptivity of quality of the object of this pursuit, but he is reported to have achieved the rare objective of sharing a bed with a man and his wife.

Now while all three might merit consideration for their qualifications, it would be breaking with tradition to give a tripartite responsibility, so after due consideration of all the facts.

It is therefore resolved that the outstanding candidate for this office is Dr. ALAN BERRYMAN.

TREASURER'S REPORT

Balance on Hand February 20, 1967		$344.45
Expenses for 1967 Meeting		1,649.65
Received from Registration		1,618.85
Preparation of 1967 Proceedings		17.00
Balance on Hand April 4, 1968	$296.65	

MEMBERSHIP ROSTER

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Note: Active members registered at the Conference in Berkeley, California, March 4-7, 1968, are indicated by an asterisk.

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